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Research Article

ANTI-TERMITE EFFICACY OF *ARGEMONE MEXICANA* L. FOR THE CONTROL OF INDIAN WHITE TERMITE, *ODONTOTERMES OBESUS* (Ramb.)

Nagare G. J and Pardeshi A. B*

Department of Zoology, Deogiri College Aurangabad, (M.S.)

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ABSTRACT

Termiticidal effect of methanol, aqueous and hexane solvent leaves extract of *Argemone mexicana* were studied against *Odontotermes obesus.* The plant leaves were dried, powdered and extracted with methanol, aqueous and hexane solvent in soxhlet apparatus for 24 hrs. The 10 termites were exposed to various concentrations (2.5, 5.0, 7.5, 10.0, 12.5 and 15 mg/ml) of methanol, aqueous and hexane plant extract of *Argemone mexicana* and percent mortality were recorded after 24 hrs.
The termiticidal activity of leaves extract of *Argemone mexicana* were (LD_{10}= 5.162 mg/ml, LD_{50}= 10.44 mg/ml) in methanol, (LD_{10}= 5.604 mg/ml, LD_{50}= 12.17 mg/ml) in aqueous solvent and hexane (LD_{10}= 7.665 mg/ml, LD_{50}= 11.55 mg/ml) respectively. Results revealed that the mortality was increased with increasing in concentration of the plant extracts.
The methanol solvent extract of *Argemone mexicana* showed higher termiticidal property against *Odontotermes obesus.* Statistical variance, 95% confidence limits and regression equations are presented.

INTRODUCTION

Indian white termite, *Odontotermes obesus* Ramb. Is highly destructive polyphagous insect pest, lives in huge mounds and feeds on cellulose material an almost anything which contains carbohydrate. It causes economic damage to commercial wood, fibers cellulose, sheets, papers, clothes, woolens and mats, and woody building material and infests green standing foliages, cereals stored in godown. The majority of the termites are controlled by using chemical insecticides such as chlorodane, cypermethrin, hydroquinone, and indoxacarb have been used. Due to their longer residual persistence and higher toxic effect, that harms the environment, humans and many beneficial organisms. Thus, it is pivotal and well accepted that other control methods such as physical prevention, cultural actions and organic and environmentally friendly compounds are essential for termite's management.

With a greater awareness of hazards associated with the use of synthetic pesticides there has been an increase need to explore suitable alternative method for termite control. Farmers use different plant material to protect their crops from termites. Natural products in their crude form or plant extract provide unlimited opportunities as termiticide. Plant derived pesticides are eco-friendly, nontoxic to non-target organisms, non-persistent in nature, besides they do not promote drug resistance [1]. Plants are rich sources of natural substances that can be utilized in the development of environmentally safe methods for insect control [2]. A broad range of plants are toxic, repellent, or have some antifeedant properties several of which were regarded as insecticides [3, 4]. The plant extracts of *Cissus quadrangularis* (Vitaceae), *Pennisetum purpureum* Schumach (Poaceae) and *Vetiveria zizanoides* Nash (Poaceae) were examined for their termiticidal activity against *Macrotermes subhyalinus* Smeathman and *Trinervitermes geminatus* Wasmann [5]. *Capparis deciduas* and its combinatorial mixtures were evaluated to observe the anti-termite efficacy against Indian white termite, *Odontotermes obesus*. [6,7]. Termiticide potential of six plant derived essential oils and their thirteen major active chemical constituents were investigated for their termiticidal activities against the termites, *Heterotermes sulcatus* [8]. *Macrotermes* are serious pest of some agricultural crops and tree plantations that is responsible for the majority of crop damage and 90% of tree mortality in forestry and provides entry for secondary infection by pathogens. Many plants have however, developed effective defenses against termites. Therefore evaluated the bio-activity of aqueous extracts from citrus: *Citrus sinensis*, cocoa: *Theobroma cacao*, sunflower: *Tithonia diversifolia* and cashew: *Anacardium occidentale* for the management of *Macrotermes bellicosus* on the field and in the laboratory. Results showed that extracts from the plants caused 80-100% mean insect mortality after 10 h of insect exposure [9].

Corresponding author:* **Pardeshi A. B
Department of Zoology, Deogiri College Aurangabad, (M.S.)

Termites are found throughout the world and are a perennial economical issue. Some plants are bestowed with anti-termite compounds which prevent termite infestation. *Achyranthes asapera, Sida acuta, Syzygium cumini* and *Terminalia arjuna* examined for anti-termite potential against *Odontotermes obesus* [10].

This paper reports the results of research on the anti-termite efficacy of methanol, aqueous and hexane extracts of *Argemone mexicana* for the control of Indian white termite, *Odontotermes obesus*.

The plant, *Argemone mexicana* Linn. belongs to the family Papaveraceae and It is a common plant found everywhere by road-sides and fields in India. *A. mexicana* is considered as an important medicinal plant in India and long been used for dropsy, jaundice, ophthalmia, scabies and cutaneous infections [11, 12, 13]. Crude *A. mexicana* extracts were demonstrated to have ovicidal and larvicidal activity against lepidopteran, dipteran, coleopteran, and hemipteran pests [14, 15, 16]. These extracts have a wide range of sub lethal effects including, reduced fecundity and fertility, molting disorders, morphogenetic defects [17], and repellency (Majeed and Abidunnisa 2011) [18].

Desai *et al.,* [19] investigated alkaloid, flavonoid, glycoside, saponins, tannin, phenol, lignin, steroid and terpenes in the methanolic plant extracts of *Argemone mexicana*.

Sabiha *et al.,* [20] found repellent activity of *Argemone mexicana* L. extracts against *Aphis gossypii* Glover and *Tribolium castaneum.*

Zeinab [21] investigated the larvicidal activity of phytochemicals from *A. Mexicana* Linn. against the medically important vectors *Cx. pipiens* and *Ae. Aegypti*. Bosch, [22] studied the effect of crude extract from leaves of of *A. mexicana* having antifeedant effect on the larvae of *Crocidolomia binotalis* Zeller (Lepidoptera: Crambidae) and *S. litura*.

Therefore the present study was undertaken to evaluate the termiticidal activities of methanol, aqueous and hexane solvent extracts against *Odontotermes obesus*.

MATERIALS AND METHODS

Plant materials

The leaves of *Argemone mexicana* were collected and were properly identified from taxonomist. The leaves were washed three times in tap water and rinsed with distilled water, the excess water was soaked and leaves were separated and dried in shade. The dried leaves material were powdered in domestic grinder and stored in air tight container in refrigerator till further use. From the stock 50 g of powdered was extracted with 1000 ml of aqueous, methanol and hexane solvent using Soxhlet apparatus for 24 hrs separately.

Termites

Odontotermes obesus were collected from nearby farms of Aurangabad and brought to the laboratory. Traps were maintained in plastic jar containing moist soil. Active and healthy termites were used for the study within four days after field collection.

Anti-termite bioassay

The anti-termite effects of the plant extracts were tested on termites by using a 'no-choice' feeding test. Various concentration (2.5 to 15.0 mg/mL) of aqueous, methanol and hexane solvent extract of *Argemone mexicana* were applied to Whatman No. 1 filter paper and allowed to air dry completely and were placed in petri plates under laboratory condition. These treated filter papers were given as feed and 10 active termites, *Odontotermes obesus* were released in each experimental and control petri plates. Three replications were conducted. The percent mortality was calculated after 24 h and the observed data was subjected to probit analysis [23, 24]. Filter paper treated with solvent alone was used as a control.

RESULTS

The toxic effect of leaf extract of *Argemone mexicana* was evaluated against *Odontotermes obesus*. The numbers of dead *Odontotermes obesus* were counted after 24 at (2.5, 5.0, 7.5, 10.0, 12.5 and 15.0 mg/mL) doses of methanol, aqueous and hexane solvent extract of *Argemone mexicana*. The total percent mortality was observed after 24 h, and then the corrected mortality was calculated using Abbott's formula and the results are presented. The results showed that, the mortality increases with increase in concentrations (Figure and Tables).
The results of probit analysis for the estimation of LD_{10}, LD_{50}, variance, 95% confidence limits and regression equation at 24 h for the mortality of Indian white termite, *Odontotermes obesus* are presented in Table-2.

The termiticidal bioassay in methanol solvent extracts, LD_{10} = 5.162 mg/ml and LD_{50} = 10.44 mg/ml., in aqueous extract of *Argemone mexicana* was, LD_{10} = 5.604 mg/ml and LD_{50} = 12.17 mg/ml and in hexane solvent extract LD10 = 7.665 mg/ml and LD50 = 11.55 mg/ml respectively. Among the various estimate of regression based probit analysis, the $\chi 2$ values for the regression coefficients showed homogeneity to the data.

Table 1 Percent mortality of Indian white termite, *Odontotermes obesus* treated with leaf extracts of *Argemone mexicana.*

Sr. No.	Dose in mg/ml	No. of insects used	% Mortality after 24 hrs. (Methanol)	% Mortality after 24hrs. (Aqueous)	% Mortality after 24hrs. (Hexane)
1.	Control	10	--	--	--
2.	2.5	10	--	--	--
3.	5	10	10	10	
4.	7.5	10	30	20	10
5.	10	10	40	30	30
6.	12.5	10	60	50	60
7.	15	10	80	70	80

Table 2 LD_{10}, LD_{50} values with variance, 95% confidence limits and probit analysis parameters for Indian white termite, *Odontotermes obesus* after 24 h of treatment of *Argemone mexicana*.

Plant extract	LD_{10}	LD_{50}	Variance	95% CL		Regression equations	$\chi 2$
				Lower	Upper		
methanol	5.162	10.44	0.002179	0.9272	1.1102	Y= 4.1893x + 0.7322	0.4187(2)
Aqueous	5.604	12.17	0.002837	0.9811	1.1899	Y= 3.8042x +0.8707	0.5931(2)
Hexane	7.665	11.55	0.000969	1.0018	1.1238	Y= 7.1849x - 2.6364	0.0302(2)

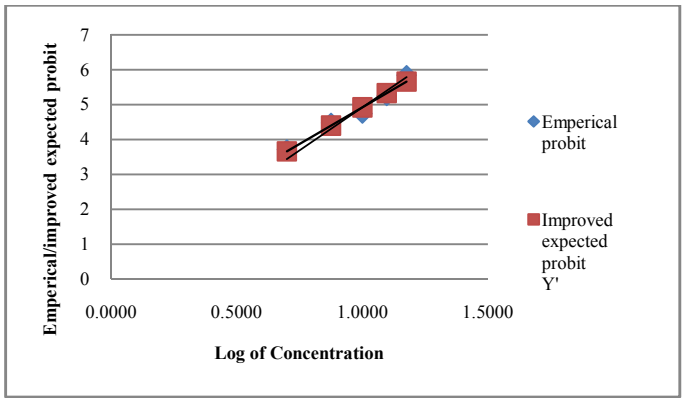

Fig 1 Regression and provisional lines for *Odontotermes obesus* exposed to methanol leaf extract of *Argemone mexicana* after 24 h.

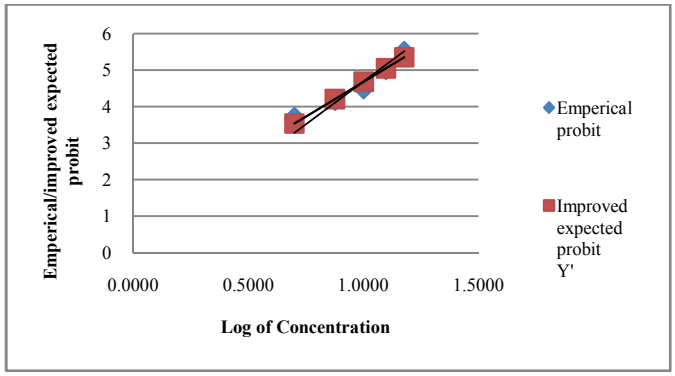

Fig 2 Regression and provisional lines for Indian white termite, *Odontotermes obesus* exposed to aqueous leaf extract of *Argemone mexicana* after 24 h.

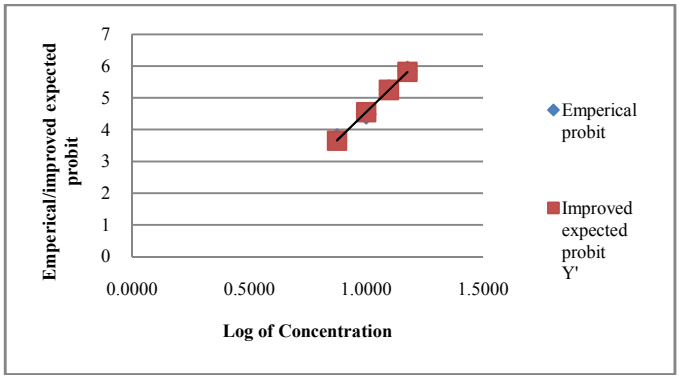

Fig 3 Regression and provisional lines for Indian white termite, *Odontotermes obesus* exposed to hexane leaf extract of *Argemone mexicana* after 24 h.

DISCUSSION

Indian white termite, *Odontotermes obesus* is one of severe destructive pest which causes economic damage to commercial wood, fibers, paper sheet, clothes, woolens and mats and seriously infests agricultural crops and forest products.

In the present study, we have tried to control termite infestation ecofriendly by applying methanol, aqueous and hexane solvent plant extract of *Argemone mexicana*. Our results indicates that the plant, *Argemone mexicana* possess anti-termite potential.
In insect-plant interactions, insects often have unique adaptation to their host plants in locating and selecting the plants by the use of chemical, visual and mechanical cues [25]. The unsuitable plants are avoided by detection of other chemical cues; such chemical substances may have repellent or toxic properties against insects [26]. Based on this principle, botanical pesticides are invented and utilized for control of insect pests. Crude extracts from the leaf, stem, root and seeds of various plant species have been reported to possess antifeedant, insecticidal, and/or growth inhibitory properties [27].

Four plant species of *Achyranthes aspera*, *Sida acuta, Syzygium cumini* and *Terminalia arjuna* was anti-termite potential against *Odontotermes obesus*. The anti-termite potential of each extract revealed that among the plants examined, *T. arjuna* stem methanol extract exhibited the highest termiticidal potential (74.67%) followed by *S. cumini* leaf and stem methanolic extracts(70% ,67% respectively). Aqueous extract of *A. aspera* was found effective against termites and exhibited 56% mortality over a period of 48hrs [10]. The hexane dried leaf extracts of *Tagetes erecta* and the hexane extracts of *Flourensia cernua* were reported to possess termiticidal activity against Formosan subterranean termite, *Coptotermes formosanus* and *Reticulitermes sp.* [28, 29]. An antitermite response was found in methanol leaves extract of *Cordia dichotoma* at different dilutions i.e. (0.5%, 1%, 2 %) against *Odontotermes obesus* [30]. The 2% ethyl acetate extract possesses highest anti-termite potential. Ethanol extract of Sappan (*Caesalpinia sappan*) has a significant potential in the control of termites at 30% concentration [31]. Termiticidal effect of *Tagetes erecta* and *Citrus sinensis* oil also found against termite, *Odontotermes obesus* [32]. The plants reviewed show good insecticidal properties against termites [33]. Seven botanical extract were reported as anti-termite property in Ethiopia. Aqueous extracts of tobacco leaves, *Nicotiana tabacum*, Birbira seeds, *Militia ferruginea* and Endod leaves, *Phytolacca dodecandra* were achieved 100% mortality after 24 hours [34].

Under laboratory conditions when *C. cephalonica* larvae were fed with rice grains coated with diverse types of organic extracts from *A. mexicana* at concentrations of 1.5 and 2.0 mL/kg, the pupal mortality reached up to 40% [16]. Ashwini *et al.,* [35] found that the toxicity bioassay of *A. mexicana* extracts caused greater mortality on third instars larvae (LD50 = 5.33 mg-1) than *C. inerme* (LD50 = 7.26 mg-1).

The finding of the present investigation revealed that, the leaves extract of *Argemone mexicana* possesses remarkable anti-termite activity against *Odontotermes obesus*. The study needs further investigation to find out active ingredients responsible for termiticidal properties of *Argemone mexicana* and to reach any final recommendations.

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